Mathematics
Grade 8

2011

Maryland Common Core State Curriculum Framework

Adapted from the Common Core State Standards for Mathematics

MARYLAND STATE DEPARTMENT OF EDUCATION
PREPARING WORLD CLASS STUDENTS

Contents

Introduction

These Standards define what students should understand and be able to do in their study of mathematics. Asking a student to understand something means asking a teacher to assess whether the student has understood it. But what does mathematical understanding look like? One hallmark of mathematical understanding is the ability to justify, in a way appropriate to the student's mathematical maturity, *why* a particular mathematical statement is true or where a mathematical rule comes from. There is a world of difference between a student who can summon a mnemonic device to expand a product such as $(a + b)(x + y)$ and a student who can explain where the mnemonic comes from. The student who can explain the rule understands the mathematics, and may have a better chance to succeed at a less familiar task such as expanding $(a + b + c)(x + y)$. Mathematical understanding and procedural skill are equally important, and both are assessable using mathematical tasks of sufficient richness.

The Standards set grade-specific standards but do not define the intervention methods or materials necessary to support students who are well below or well above grade-level expectations. It is also beyond the scope of the Standards to define the full range of supports appropriate for English language learners and for students with special needs. At the same time, all students must have the opportunity to learn and meet the same high standards if they are to access the knowledge and skills necessary in their post-school lives. The Standards should be read as allowing for the widest possible range of students to participate fully from the outset, along with appropriate accommodations to ensure maximum participation of students with special education needs. For example, for students with disabilities reading should allow for use of Braille, screen reader technology, or other assistive devices, while writing should include the use of a scribe, computer, or speech-to-text technology. In a similar vein, speaking and listening should be interpreted broadly to include sign language. No set of grade-specific standards can fully reflect the great variety in abilities, needs, learning rates, and achievement levels of students in any given classroom. However, the Standards do provide clear signposts along the way to the goal of college and career readiness for all students.

How to Read the Maryland Common Core Curriculum Framework for Grade 8

This framework document provides an overview of the standards that are grouped together to form the domains of study for Grade 8 mathematics. The standards within each domain are grouped by clusters and are in the same order as they appear in the Common Core State Standards for Mathematics. This document is not intended to convey the exact order in which the standards within a domain will be taught nor the length of time to devote to the study of the unit.

The framework contains the following**:**

- **Domains** are intended to convey coherent groupings of content.
- **Clusters** are groups of related standards**.** A description of each cluster appears in the left column.
- **Standards** define what students should understand and be able to do.
- **Essential Skills and Knowledge** statements provide language to help teachers develop common understandings and valuable insights into what a student must know and be able to do to demonstrate proficiency with each standard. Maryland mathematics educators thoroughly reviewed the standards and, as needed, provided statements to help teachers comprehend the full intent of each standard. The wording of some standards is so clear, however, that only partial support or no additional support seems necessary.
- **Standards for Mathematical Practice** are listed in the right column.

Formatting Notes

- *Black – wording from the Common Core State Standards document*
- ***Red Bold****- items unique to Maryland Common Core State Curriculum Frameworks*
- ***Blue bold*** *– words/phrases that are linked to clarifications*
- ***Green bold*** *– codes for standards that are referenced from other grades or standards, and are hot-linked to a full description*
- ***Purple bold*** *– strong connection to current state curriculum for this grade*

Standards for Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

1. Make sense of problems and persevere in solving them.
Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2. Reason abstractly and quantitatively.
Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3. Construct viable arguments and critique the reasoning of others.

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

4. Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5. Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6. Attend to precision.
Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7. Look for and make use of structure.
Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5+ 7 × 3, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 – 3(x – y)2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers *x* and *y*.

8. Look for and express regularity in repeated reasoning.
Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y – 2)/(x – 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x – 1)(x + 1)$, $(x – 1)(x^2 + x + 1)$, and $(x – 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Connecting Standards for Mathematical Practice to Standards for Mathematical Content

The Standards for Mathematical Practice describe ways in which developing student practitioners of the discipline of mathematics increasingly ought to engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle and high school years. Designers of curricula, assessments, and professional development should all attend to the need to connect the mathematical practices to mathematical content in mathematics instruction. The Standards for Mathematical Content are a balanced combination of procedure and understanding. Expectations that begin with the word "understand" are often especially good opportunities to connect the practices to the content. Students who lack understanding of a topic may rely on procedures too heavily. Without a flexible base from which to work, they may be less likely to consider analogous problems, represent problems coherently, justify conclusions, apply the mathematics to practical situations, use technology mindfully to work with the mathematics, explain the mathematics accurately to other students, step back for an overview, or deviate from a known procedure to find a shortcut. In short, a lack of understanding effectively prevents a student from engaging in the mathematical practices. In this respect, those content standards which set an expectation of understanding are potential "points of intersection" between the Standards for Mathematical Content and the Standards for Mathematical Practice. These points of intersection are intended to be weighted toward central and generative concepts in the school mathematics curriculum that most merit the time, resources, innovative energies, and focus necessary to qualitatively improve the curriculum, instruction, assessment, professional development, and student achievement in mathematics.

Codes for Common Core State Standards: Mathematics Grades K – 12

Grades K – 8		Applicable Grades
CC	Counting & Cardinality	K
EE	Expressions & Equations	6, 7, 8
F	Functions	8
G	Geometry	K, 1, 2, 3, 4, 5, 6, 7, 8
MD	Measurement & Data	K, 1, 2, 3, 4, 5
NBT	Number & Operations (Base Ten)	K, 1, 2, 3, 4, 5
NF	Number & Operations (Fractions)	3, 4, 5
NS	Number System	6, 7, 8
OA	Operations & Algebraic Thinking	K, 1, 2, 3, 4, 5
RP	Ratios & Proportional Relationship	6, 7
SP	Statistics & Probability	6, 7, 8
Modeling		
No Codes		Not determined
High School		
Algebra (A)		
A-APR	Arithmetic with Polynomial & Rational Expressions	8 -12
A-CED	Creating Equations	8 -12
A-REI	Reasoning with Equations & Inequalities	8 -12
A-SSE	Seeing Structure in Expressions	8 -12
Functions (F)		
F-BF	Building Functions	8 -12
F-IF	Interpreting Functions	8 -12
F-LE	Linear, Quadratic & Exponential Models	8 -12
F-TF	Trigonometric Functions	Not determined
Geometry (G)		
G-C	Circles	Not determined
G-CO	Congruence	Not determined
G-GMD	Geometric Measurement & Dimension	Not determined
G-MG	Modeling with Geometry	Not determined
G-GPE	Expressing Geometric Properties with Equations	Not determined
G-SRT	Similarity, Right Triangles & Trigonometry	Not determined
Number & Quantity (N)		
N-CN	Complex Number System	Not determined
N-Q	Quantities	Not determined
N-RN	Real Number System	8 -12
N-VM	Vector & Matrix Quantities	Not determined
Statistics (S)		
S-ID	Interpreting Categorical & Quantitative Data	8 -12
S-IC	Making Inferences & Justifying Conclusions	Not determined
S-CP	Conditional Probability & Rules of Probability	Not determined
S-MD	Using Probability to Make Decisions	Not determined
Modeling		
No Codes		Not determined

DOMAIN: THE NUMBER SYSTEM (NS)		
Cluster	**Standard**	**Mathematical Practices**
Know that there are numbers that are not rational, and approximate them by rational numbers.	**8.NS.1:** Know that numbers that are not **rational** are called **irrational**. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number. Essential Skills and Knowledge • **Knowledge of differences between rational and irrational** • **Knowledge of definition and description of rational and irrational** • **Ability to identify and provide examples of rational versus irrational numbers, of the real number system** **8.NS.2:** Use **rational** approximations of **irrational** numbers to compare the size of **irrational** numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). *For example, by* ***truncating*** *the decimal expansion of* $\sqrt{2}$*, show that* $\sqrt{2}$ *is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.* Essential Skills and Knowledge • **Ability to round to the hundredths place** • **Ability to use a number line that specifies in tenths and hundredths the value between two whole numbers** • **Ability to use a number line that extends indefinitely, such as π**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: EXPRESSIONS AND EQUATIONS (EE)		
Cluster	**Standard**	**Mathematical Practices**
Work with radicals and integer exponents.	**8.EE.1:** Know and apply the **properties of integer exponents** to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{-5} = 3^{-3} = \frac{1}{3^3} = \frac{1}{27}$ Essential Skills and Knowledge • **Ability to recognize and apply the following properties of integer exponents:** o **Product/Quotient of Powers** o **Negative Exponents** o **Zero Exponents** o **Power of Powers** • **Ability to apply a combination of properties to show equivalency** **8.EE.2:** Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive **rational** number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is **irrational**. Essential Skills and Knowledge • **Ability to recognize and apply the following:** o **Perfect Squares** o **Perfect Cubes** o **Square Roots (Symbol Notation)** o **Cube Roots (Symbol Notation)** o **Principal (positive) roots/negative roots** • **Ability to recognize and use inverse relationships of squares with square roots and of cubes with cube roots** **8.EE.3:** Use numbers expressed in the form of a single digit times an **integer power of 10** to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as* 3×10^8 *and the population of the world as* 7×10^9*, and determine that the world population is more than 20 times larger.* Essential Skills and Knowledge • **Ability to compare large and small numbers using properties of integer exponents (see 8.EE.1)**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: EXPRESSIONS AND EQUATIONS (EE)… continued

Cluster	Standard	Mathematical Practices
Work with radicals and integer exponents. (continued)	**8.EE.4:** Perform operations with numbers expressed in **scientific notation**, including problems where both **decimal** and scientific notation are used. Use **scientific notation** and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology. Essential Skills and Knowledge • **Ability to compare units of measure** • **Ability to read scientific notation on a calculator**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Understand the connections between proportional relationships, lines, and linear equations.	**8.EE.5:** Graph proportional relationships, interpreting the **unit rate** as the **slope** of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.* Essential Skills and Knowledge • **Ability to relate and compare graphic, symbolic, numerical representations of proportional relationships** • **Ability to calculate constant rate of change/slope of a line graphically** • **Ability to understand that all proportional relationships start at the origin** • **Ability to recognize and apply direct variation** **8.EE.6:** Use similar triangles to explain why the slope m is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin, and the equation $y = mx + b$ for a line intercepting the vertical axis at b. Essential Skills and Knowledge • **Ability to understand that similar right triangles *(provide diagram of graphical notation)* can be used to establish that slope is constant for a non-vertical line (see 8.G.1)** • **Ability to graphically derive equations $y = mx$ and $y = mx + b$** • **Ability to differentiate between zero slope and undefined slope** • **Ability to understand how the y-intercept translates a line along the y-axis (families of graphs)**	

DOMAIN: EXPRESSIONS AND EQUATIONS (EE)… continued		
Cluster	**Standard**	**Mathematical Practices**
Analyze and solve linear equations and pairs of simultaneous linear equations.	**8.EE.7: Solve linear equations in one variable** **7a.** Give examples of linear equations in one variable with **one solution**, **infinitely many solutions**, or **no solutions**. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an **equivalent equation** of the form $x = a$, $a = a$, or $a = b$ results (a and b are different numbers). Essential Skills and Knowledge • **Ability to build on prior knowledge of solving linear equations (see 7.EE.4)** **7b.** Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the **distributive property** and **collecting like terms**. Essential Skills and Knowledge • **See the skills and knowledge that are stated in the Standard.** **8.EE.8: Analyze and solve pairs of simultaneous linear equations** **8a.** Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. Essential Skills and Knowledge • **Ability to solve systems of equations numerically or by graphing** **8b.** Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.* Essential Skills and Knowledge • **Ability to solve systems of two linear equations in two variables algebraically using substitution or elimination** • **Ability to discuss efficient solution methods with a system of equations - graphically and algebraically** • **Ability to solve simple cases by inspection, one solution, infinitely many solutions, or no solution.**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: EXPRESSIONS AND EQUATIONS (EE)… continued		
Cluster	**Standard**	**Mathematical Practices**
Analyze and solve linear equations and pairs of simultaneous linear equations. (continued)	**8c.** Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.* **Essential Skills and Knowledge** • **Ability to write an equation given two points** • **Ability to write equations from context** • **Ability to interpret the solution to a system of equations in context**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: FUNCTIONS (F)

Cluster	Standard	Mathematical Practices
Define, evaluate, and compare functions.	**8.F.1:** Understand that a **function** is a rule that assigns to each input exactly one output. The **graph of a function** is the set of ordered pairs consisting of an input and the corresponding output (**function notation** is not required in Grade 8). Essential Skills and Knowledge • **Ability to recognize functional relationships and apply the following:** o **Function Tables** o **Vertical Line Test** o **Domain/Input/Independent (x-coordinate)** o **Range/Output/Dependent (y-coordinate)** **8.F.2:** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.* Essential Skills and Knowledge • **Ability to compare properties – constant rate of change/slope, increasing, decreasing, y-intercept, parallel lines, slopes of horizontal/vertical lines (see 8.EE.5 and 8.EE.6)** • **Ability to calculate slope/rate of change of a line graphically from a table or verbal description** • **Ability to determine y-intercept from table, equation, graph, or verbal description** **8.F.3:** Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function* $A= S^2$ *giving the area of a square as a function of its side length is not linear because its graph contains the points (1, 1), (2, 4) and (3, 9), which are not on a straight line.* (SC 8) Essential Skills and Knowledge • **Ability to distinguish between linear and non-linear functions** • **Ability to identify and define independent variables and dependent variables in equations that represent authentic scenarios**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: FUNCTIONS (F)… continued		
Cluster	**Standard**	**Mathematical Practices**
Use functions to model relationships between quantities.	**8.F.4:** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (*x*, *y*) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. Essential Skills and Knowledge • **Ability to calculate and interpret constant rate of change /slope from a scenario, table, graph, or two points** • **Ability to calculate and interpret initial value (y-intercept) from a scenario, graph, or table** • **Ability to represent linear relationships numerically, graphically (table), and algebraically (equation)** **8.F.5:** Describe qualitatively the **functional relationship** between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. Essential Skills and Knowledge • **Ability to distinguish rate of change within an interval of a function** • **Ability to interpret directionality and steepness of the graph of a function** • **Ability to sketch a graph given algebraic context or a scenario (slope and initial value)** • **Ability to create a plausible story given a graph**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: GEOMETRY (G)		
Cluster	**Standard**	**Mathematical Practices**
Understand congruence and similarity using physical models, transparencies, or geometry software.	**8.G.1:** Verify experimentally the properties of **rotations**, **reflections,** and **translations**. **1a.** Lines are taken to lines, and line segments to line segments of the same length. Essential Skills and Knowledge • **Ability to conduct experiments which show that rotations, reflections, and translations of lines and line segments are rigid** • **Ability to use transformation notation (A → A' → A")** • **Ability to use physical models and software to demonstrate transformations** **1b.** Angles **are taken to** angles of the same measure. Essential Skills and Knowledge • **Ability to conduct experiments which show that rotations, reflections, and translations of angles are rigid** • **Ability to use transformation notation (∠A → ∠A' → ∠A")** • **Ability to use physical models and software to demonstrate transformations** **1c.** Parallel lines **are taken to** parallel lines. Essential Skills and Knowledge • **Ability to conduct experiments which show that rotations, reflections, and translations of parallel lines are rigid** • **Ability to use transformation notation (A → A' → A")** • **Ability to use physical models and software to demonstrate transformations** **8.G.2:** Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. Essential Skills and Knowledge • **Ability to use a sequence of transformations and map one figure to a second figure to show congruency** • **Ability to describe a sequence of transformations, needed to generate the image, given its pre-image**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: GEOMETRY (G)… continued		
Cluster	**Standard**	**Mathematical Practices**
Understand congruence and similarity using physical models, transparencies, or geometry software. (continued)	**8.G.3:** Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. Essential Skills and Knowledge • **Ability to verbally describe the location on a coordinate grid of an image with respect to the pre-image** • **Ability to extend with algebraic rules of transformations** • **Ability to write algebraic rules for transformations given an image and pre-image on coordinate plane, using multiple transformations** • **Ability to discuss the difference between rigid and non-rigid transformations** **8.G.4:** Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. Essential Skills and Knowledge • **Ability to use a sequence of transformations, and to map one figure to a second to show similarity** • **Ability to show that similar figures maintain shape but alter size through dilation (scale factor)** • **Ability to demonstrate that congruency is a special case of similarity (scale factor of 1)** • **Ability to describe the sequence of transformations needed to generate an image, given its pre-image** **8.G.5:** Use informal arguments to establish facts about the **angle sum** and **exterior angle of triangles**, about the angles created when **parallel lines are cut by a transversal**, and the **angle- angle criterion for similarity of triangles**. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* Essential Skills and Knowledge • **Ability to use and apply facts that result from parallel lines cut by a transversal**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: GEOMETRY (G)… continued		
Cluster	**Standard**	**Mathematical Practices**
Understand and apply the Pythagorean Theorem.	**8.G.6:** Explain a **proof of the Pythagorean Theorem** and its **converse**. Essential Skills and Knowledge • **See the skills and knowledge that are stated in the Standard.** **8.G.7:** Apply the **Pythagorean Theorem** to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. **(SC 8)** Essential Skills and Knowledge • **See the skills and knowledge that are stated in the Standard.** **8.G.8:** Apply the **Pythagorean Theorem** to find the distance between two points in a coordinate system. Essential Skills and Knowledge • **Ability to derive the distance formula from the Pythagorean Theorem, using the hypotenuse of a triangle**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.	**8.G.9:** Know the formulas for the **volumes of cones**, **cylinders,** and **spheres** and use them to solve real-world and mathematical problems. Essential Skills and Knowledge • **See the skills and knowledge that are stated in the Standard.**	

DOMAIN: STATISTICS AND PROBABILITY (SP)		
Cluster	**Standard**	**Mathematical Practices**
Investigate patterns of association in bivariate data.	**8.SP.1:** **Construct and interpret scatter plots** for **bivariate measurement data** to investigate patterns of association between two quantities. Describe patterns such as **clustering**, **outliers**, **positive or negative association**, **linear association**, and **nonlinear association**. Essential Skills and Knowledge • **Ability to integrate technology and relate the scenarios to authentic student-centered situations** • **Ability to keep paired data organized in relation to one another within two sets of quantities** **8SP2:** Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. Essential Skills and Knowledge • **See the skills and knowledge that are stated in the Standard.** **8.SP.3:** Use the **equation of a linear model** to solve problems in the context of **bivariate measurement data**, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.* Essential Skills and Knowledge • **Ability to integrate technology and to relate the scenarios to authentic student-centered situations**	**1. Make sense of problems and persevere in solving them.** **1. Reason abstractly and quantitatively.** **2. Construct viable arguments and critique the reasoning of others.** **3. Model with mathematics.** **4. Use appropriate tools strategically.** **5. Attend to precision.** **6. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**

DOMAIN: STATISTICS AND PROBABILITY (SP)… continued		
Cluster	**Standard**	**Mathematical Practices**
Investigate patterns of association in bivariate data. (continued)	**8.SP.4:** Understand that patterns of association can also be seen in **bivariate categorical data** by displaying **frequencies** and **relative frequencies** in a **two-way table**. Construct and interpret a **two-way table** summarizing data on two **categorical variables** collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?* Essential Skills and Knowledge • **Ability to integrate technology and to relate the scenarios to authentic student-centered situations**	**1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**